

WHAT IS CLAIMED:

1. Apparatus for applying heat to articles enclosed in shrink-wrap film, the apparatus comprising:

- 5 (a) a conveyor having a plurality of first apertures therethrough;
- (b) wherein the conveyor moves in a first direction;
- (c) a source of heated air;
- (d) a heated air plenum under the conveyor and supporting the conveyor, the  
10 plenum having a top surface having a plurality of second apertures  
therethrough;
- (e) a fan blowing heated air from the source of heated air through the heated air  
plenum, through the second apertures, and through the first apertures;
- (f) a return air plenum returning air to the source of heated air; and
- (g) a shroud partially enclosing the conveyor along the first direction and spaced  
15 therefrom at a displacement, forming therewith a film shrinking area between  
the conveyor and the shroud.

2. The apparatus of claim 1, wherein the heated air plenum further comprises a bottom surface spaced from and opposing the top surface and forming a duct therebetween, the duct having a height, the height progressively decreasing along the first direction.

20 3. The apparatus of claim 1, wherein the first apertures and the second apertures are in substantial alignment as the conveyor moves along the first direction.

4. The apparatus of claim 1, further comprising a conveyor cooling fan.

25 5. The apparatus of claim 1, further comprising a side air duct adjacent the conveyor along the first direction, the side air duct transmitting heated air from the heated air plenum.

6. The apparatus of claim 5, further comprising a supplemental heat source for the side air duct.

7. The apparatus of claim 1, wherein the conveyor further comprises at least two side-by-side chains running along the first direction.

8. The apparatus of claim 7, further comprising a center air duct between the two chains, the center air duct transmitting heated air from the heated air plenum.

9. The apparatus of claim 8, further comprising a supplemental heat source for the center air duct.

5 10. The apparatus of claim 1, wherein the displacement is variable, thereby accomodating articles of different sizes.

11. The apparatus of claim 10, further comprising a means for varying the displacement.

10 12. The apparatus of claim 11, wherein the means for varying the displacement is manual.

13. The apparatus of claim 11, wherein the means for varying the displacement is automatic.

15 14. The apparatus of claim 1, wherein the second apertures are about 7/16" to 7/32" in size, thereby resulting in substantially vertical laminar air flow through the second apertures.

15. The apparatus of claim 8, wherein the air flow from the center air duct is adjustable.

16. The apparatus of claim 8, wherein the air flow from the center air duct is diffused.

20 17. The apparatus of claim 1, wherein the second apertures further comprise nozzles.

18. The apparatus of claim 1, further comprising a film separator on the conveyor.

19. The apparatus of claim 7, further comprising a film separator between the conveyor chains.

25 20. The apparatus of claim 1, further comprising an air flow control mechanism controlling the volume of heated air passing through the second apertures.

21. The apparatus of claim 20, wherein the air flow control mechanism comprises one or more air lanes in the heated air plenum.

22. The apparatus of claim 21, further comprising one or more baffles selectively blocking air flow across the one or more air lanes.

23. A heat tunnel for applying heated air to articles enclosed in shrink-wrap film, the heat tunnel comprising:

- (a) a moving conveyor chain comprising first apertures separated by link bars;
- (b) a heated air plenum under the conveyor chain and supporting the conveyor chain, the heated air plenum having a top surface having second apertures therethrough;
- (c) a source of heated air;
- (d) a side air duct receiving heated air and directing the air transversely across the conveyor chain;
- (e) a return air plenum; and
- (f) a shroud partially enclosing the conveyor chain and spaced therefrom, forming therewith a film shrinking area between the conveyor and the shroud.

24. The heat tunnel of claim 23, wherein the heated air plenum is tapered vertically along the conveyor chain in the direction of the conveyor chain.

25. The heat tunnel of claim 23, further comprising at least one additional conveyor chain.

26. The heat tunnel of claim 25, further comprising a center air duct between the conveyor chains and directing heated air transversely across the conveyor chains.

27. The heat tunnel of claim 26, further comprising a supplemental heat source for the center air duct.

28. The heat tunnel of claim 23, wherein the spacing between the shroud and the conveyor chain is variable, thus accommodating different sized articles.

29. The heat tunnel of claim 28, further comprising a motor lowering and raising the shroud relative to the conveyor chain.

30. The heat tunnel of claim 23, wherein the second apertures are in substantial linear alignment with the first apertures.

31. A heat tunnel for applying heated air to articles enclosed in shrink-wrap film, the heat tunnel comprising:

- (a) at least one air supply unit, the air supply unit further comprising a source of heated air, a fan, a heated air plenum, air ducts, and a return air plenum;
- (b) a conveyor chain; and
- (c) a heat shroud spaced from the conveyor chain, wherein multiple air supply units can be provided along the conveyor to create a heat tunnel of desired length.

32. The heat tunnel of claim 31, wherein the heated air plenum is tapered vertically along the conveyor chain in the direction of the conveyor chain.

33. The heat tunnel of claim 31, further comprising at least one additional conveyor chain.

34. The heat tunnel of claim 33, further comprising a center air duct between the conveyor chains and directing heated air transversely across the conveyor chains.

35. The heat tunnel of claim 34, further comprising a supplemental heat source for the center air duct.

36. The heat tunnel of claim 31, wherein the spacing between the shroud and the conveyor chain is variable, thus accommodating different sized articles.

37. The heat tunnel of claim 36, further comprising a motor lowering and raising the shroud relative to the conveyor chain.

38. The heat tunnel of claim 31, wherein the conveyor chain further comprises first apertures separated by link bars, wherein the heated air plenum has a top surface having a plurality of second apertures, and wherein the first apertures and the second apertures are in substantial linear alignment.

39. The heat tunnel of claim 31, wherein the source of heated air is removable from the air supply unit.

40. The heat tunnel of claim 31, wherein the source of heated air is controlled to maintain a constant temperature in the heated air plenum.

41. The heat tunnel of claim 31, further comprising a sensor in the heated air plenum, the sensor controlling the temperature of the source of heated air.

42. The heat tunnel of claim 31, wherein the fan has a variable speed to adjust the flow of heated air through the heated air plenum.

5 43. The heat tunnel of claim 31, wherein the fan is removable from the air supply unit.

44. The heat tunnel of claim 31, further comprising a side air duct directing heated air transversely across the conveyor chain.

10 45. The heat tunnel of claim 44, further comprising a supplemental heat source for the side air duct.

46. The heat tunnel of claim 44, wherein the side air duct has an adjustable opening.

47. The heat tunnel of claim 44, further comprising a diffuser on the side air duct.

48. A modular air supply unit for a heat tunnel for applying heated air to articles enclosed in shrink-wrap film, the air supply unit comprising a source of heated air, a fan, a heated air plenum, air ducts, and a return air plenum, the fan blowing heated air from the source of heated air along the heated air plenum.

5 49. The modular air supply unit of claim 48, wherein a plurality of the modular air supply units may be serially arranged thereby producing a heat tunnel of variable length.

50. The modular air supply unit of claim 48, the heated air plenum being tapered in cross section transversely to the direction of heated air movement with the cross-sectional area of the plenum progressively decreasing away from the fan.

10 51. The modular air supply unit of claim 48, further comprising a removable center air duct receiving heated air from the heated air plenum.

52. The modular air supply unit of claim 51, further comprising a supplemental heat source heating air passing through the center air duct.